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J. ROSE BRADFORD, D.Sc., M.D., F.R.C.P., F.R.S.
PHYSICIAN TO UNIVERSITY COLLEGE HOSPITAL

AND

H. BATTY SHAW, M.D., F.R.C.S.
LATE HOUSE PHYSICIAN TO UNIVERSITY COLLEGE HOSPITAL

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Cases of acute leukæmia are of sufficient rarity and interest for the following series of cases to be put on record. Two cases were observed by one of us (J. R. B.) as long ago as 1890; the other three have been seen during the past year (1897). Of these three latter cases one was seen by one of us (J. R. B.) in private, in consultation with Dr. Bontor of Berkhamsted. All the other four cases, two in 1890 and two in 1897, were admitted into University College Hospital, some under the care of Dr. Bradford, and some under the care of Dr. Ringer; and we are indebted to Dr. Ringer's courtesy for permission to include his cases in this series.

The nature of the first case in 1890 was detected, one may say, by accident, as a result of an examination of the blood; and the first case being thus recognised the

detection of the other four was easy, as all the cases presented a most remarkable similarity clinically. In three cases a more complete examination of the patient and of the blood was possible; in the remaining two the record is imperfect: in both of these—one a hospital and the other a private case—the patient was only seen when practically moribund, and hence the examination possible was necessarily very imperfect. In all five cases, however, the blood was examined, and in four cases a post-mortem examination was made. This was not obtained in the fifth case.

Case 1.—Roland C—, aged 30, married, checker on the Midland Railway, was admitted into University College Hospital on September 30th, 1890, complaining of (1) headache; (2) sore throat; (3) tender gums, and (4) pricking pain in the left hypochondrium.

Past illnesses.—Patient had rheumatism eight years ago; he has had tonsillitis twice, he has never had scarlet fever, and there is no history of syphilis. Both his parents are alive. He has no children. Patient has lived in London for the last ten years. He states that his home is healthy and his habits are regular. He has always been temperate, drinking one pint of beer a day, but during the past four months he has been practically an abstainer.

History of present illness.—He states that for the last three months he has suffered from headache, and during the last month has had to complain of sore throat. A fortnight ago his gums became sore and spongy. During the last month he has complained of great weakness and shortness of breath, but he has been able to go to work until a few days before admission. There is no history of epistaxis.

Present state.—Patient is a well-built man of thirty years of age. His skin and mucous membranes are very pale, and he looks intensely anæmic, and the body generally is rather wasted. He can lie in bed in any position.

There is no œdema, the fingers are not clubbed, and the muscles are very flabby. The alæ nasi do not work, and there is no dyspnœa at rest. Patient complains of loss of appetite. The tongue is covered with white fur, the breath very offensive; the gums are soft, red, spongy, and bleed readily. There is some pain in the throat, and the tonsils are swollen and spongy-looking. The uvula is large and flaccid. There is no ulceration of the mucous membrane of the gums, tonsils, tongue, or pharynx. The abdomen is rather flat. The upper limit of the liver dulness in the nipple line is at the upper border of the sixth rib, in the middle axillary line at the eighth rib; the lower edge of the liver cannot be felt. The spleen cannot be felt. Both flanks are resonant, the bowels are constipated. The H. A. B. is in the fifth interspace, and the impulse is feeble in character. Heart-sounds are weak, but there is no murmur. Pulse is 80 and regular. There is no cough or dyspnœa. Both sides of the chest move well. Percussion note is good, and the breath-sounds are well heard all over the chest. There are no râles, the vocal fremitus and vocal resonance are normal. The patient has a good deal of pain, starting in the occipital region and passing forward through the head to the frontal region. Sleep, however, is good, and there is no vomiting. The sight is normal, and there is no optic neuritis. The urine is cloudy and deposits urates, sp. gr. 1022; contains a trace of albumen, but no sugar.

October 4th.—A number of bluish-red purpuric spots are noticed on the patient's legs to-day. He still complains of his headache. The blood was examined to-day, and the number of red corpuscles in ten squares was 205, white corpuscles 55, hæmoglobin 40 per cent. (Gowers' hæmocytometer was used).

6th.—The state of the mouth is worse, the gums being more swollen, and hæmorrhage having occurred into them.

13th.—The state of the gums is very bad, and such that the patient is unable to close his mouth. The throat, however, is slightly better. The swelling and soreness of

the gums is such as to prevent any solid food being given. The blood was again examined to-day, and 239 red corpuscles and 25 white corpuscles were found in ten squares.

14th.—Patient has now a diffuse swelling involving the right side of the face, otherwise his condition is much the same. This swelling of the face got steadily worse until October 22nd, when it was found that the inside of the right cheek was greatly swollen, and that there was a considerable amount of sloughing of the mucous membrane lining the cheek and the alveolus of the upper jaw. A quantity of slough was removed, leaving a deep chasm in the cheek, which was swabbed out with 1 in 20 carbolic and dressed with iodoform. Patient is still intensely anæmic, the face is almost white.

On October 26th patient was seen by Mr. Pollard, put under chloroform, and a large quantity of slough removed from the right cheek and alveolus of the jaw. The teeth were exposed down to the fangs, owing to the sloughing of the mucous membrane of the gums. In the course of the afternoon the patient became very collapsed, pulse 120, of very low tension. He recovered, however, under free stimulation, and took his food more freely than previously. He became very steadily weaker and more anæmic, and died on October 31st. The last blood examination was made on October 30th, and showed 1 white corpuscle to 5 red, the number being 108 red in ten squares, and 21 white. The urine throughout the illness was of a pale yellow colour, sp. gr. varying from 1012 to 1025. It always contained a trace of albumen. The highest temperature during the illness was 102·2°, and the pulse ranged from 72 to 132.

Post-mortem examination.—The right cheek was stained a dark purple colour over an area two inches in diameter. There was a sloughing cavity inside the cheek, and the mucous membrane around this and that covering the alveolus of the upper jaw was greatly swollen and necrosed. The swelling of the gums, although not restricted to the right side of the mouth, was much more marked there than

on the left. There was no swelling or sloughing of the mucous membrane of the left cheek. The thymus gland was 3 inches in length, and 1½ inches in breadth at its widest point. The right lung was adherent to the chest wall, and firmly so to the diaphragm; otherwise the lungs and pleuræ were quite healthy. The heart was exceedingly pale; no valvular disease was found; muscular substance showed well-marked "tabby cat" striation. The pericardium was normal; the blood was still quite fluid. The liver pale, otherwise normal. The spleen was normal in size. The Malpighian corpuscles were not abnormally prominent. There were no infarcts, and the organ seemed of a good colour and texture. The kidneys were very pale. Ureters and bladder normal, and no calculi or deposits of uric acid were found. The intestines and Peyer's patches were normal. The pancreas was normal. The lymphatic glands all over the body were somewhat enlarged, especially in the neck. The biggest glands, however, were not larger than the thumb-nail. The abdominal glands were very soft and greenish in colour, exuding milky juice on section. The other glands were firmer. Both femora, the left humerus, and the right tibia were examined, and all showed marked changes in the marrow. The shafts of all these long bones were destitute of fatty marrow, and were occupied by soft gelatinous marrow of a red colour, and in places hæmorrhages had occurred into this marrow, and there the colour was dark red.

Case 2.—William A. H—, aged 58, engineer. Admitted to University College Hospital December 17th, 1890, complaining (1) of excessive weakness, (2) shortness of breath on exertion, (3) swelling and soreness of the gums, so that he was unable to take solid food.

Past illnesses. — There is no history of syphilis. Patient had scarlet fever badly when six years of age, but he has had no serious illness since. He has been troubled with slight colds and attacks of lumbago. His

mother is said to have died of "old age;" his father died at forty "from drink." He has four sisters alive and well. He has had three brothers, of whom two are dead, one "from drink." He works in a shed which is very draughty. He has had plenty of good food, and has been a teetotaler for the last four years. He never was a heavy drinker. He has never been out of England.

History of present illness.—About five weeks ago he states that he began to feel weak, and that he had a heavy feeling in his chest, and that he seemed to lose power in his limbs, so that on arriving at his work he felt so enfeebled that he had to return home. He went to bed, and has never been able to get about since. His mouth and gums became sore about a fortnight ago. He states that he has wasted considerably for the last five weeks.

The patient on admission was exceedingly weak and prostrate, the skin and mucous membranes being exceedingly pale, and the patient had very considerable dyspnœa on the slightest exertion. The gums were greatly swollen, the lips and teeth were covered with sordes, breath exceedingly foul. The gums were not only swollen, but in places were sloughing and necrotic. No marked swelling of the tonsils and pharynx could be made out. Patient was in an exceedingly weak state, and only a very cursory examination could be made. The lymphatic glands were found slightly enlarged. The spleen and liver could not be felt. Nothing abnormal was detected in the chest. The blood, unfortunately, was not examined until the day before death, when the proportion of white to red was found to be 1 to 10, but no count of the red corpuscles and no estimation of the hæmoglobin were made.

Patient died on December 21st, the highest temperature during the illness being 100·2°; the pulse ranged from 100 to 110; the urine was pale in colour, acid; sp. gr. 1012 to 1018, deposited urates, and contained no albumen or sugar.

Post-mortem examination.—The thymus was found to

be persistent; the blood was of a "café au lait" colour. The heart was exceedingly pale; there was no valvular disease. There were, however, petechial hæmorrhages beneath the pericardium. The left pleura was adherent, the right pleura partially adherent. There was no excess of fluid in the pericardial, pleural, or peritoneal cavities. The liver weighed 72 ounces, and was pale and fatty. The kidneys were enlarged, pale, and smooth; the capsule stripped off easily. The right weighed 6½ ounces, the left 7½ ounces. The lungs were normal. The spleen was slightly enlarged, and contained no infarcts. The mesenteric and retro-peritoneal glands were slightly enlarged, but appeared normal on section. The cervical, axillary, and inguinal lymphatic glands were also slightly enlarged. The marrow in the shafts of the long bones was red and gelatinous in appearance.

Case 3.—George D—, 19 years of age, French polisher, admitted to University College Hospital February 22nd, 1897. Patient was admitted complaining of (1) swelling and pain in the face, (2) lumps in the neck, (3) spots on the body, and (4) great weakness. For two or three days previously to January 25th, 1897, patient had not felt well, but was not so ill as to cause any anxiety. On January 25th—that is to say, about four weeks ago—he began to have "toothache" in the upper jaw, and two or three days later he noticed some swelling in his neck, which began on the left side and extended to the right side, and this swelling has gradually increased on both sides of the neck. At this time he came to the Out-patient Department, and was seen by one of us (J. R. B.), and the cervical glands were found to be enlarged, especially on the left side. An examination of the mouth was made, but no swelling of the gums, &c., was noticed. About the end of the first week in February he noticed some swelling on the roof of the mouth, more especially on the left side, and this has since increased. About February 15th his face began to swell, and there was

some puffiness of the eyelids. Three or four days before admission he noticed a number of red spots on his body. The weakness began with the illness, and has been steadily getting worse. He has also had slight headache since the beginning.

Past illnesses.—Patient had scarlet fever about eight years ago, but he gives no history of any other illness. There is no one else ill in the house.

Family history.—Father and mother alive and well. A brother of the patient died of scarlet fever ten years ago. He has an only sister alive and well. Patient works ten hours a day—the work is light. There is no history of privation, and no history of alcoholism.

Present state (February 23rd).—Patient is a youth aged 19. His face is very much swollen, more especially on the left side. He states that blood sometimes comes from the left nostril, and he is unable to breathe through the left nostril. He is intensely pale and is evidently very ill. The mouth is kept half open. The lower lip is swollen, and sordes are present on both lips. The breath is very foul. The conjunctivæ are injected. The tongue is very coated. The teeth are very irregular, and those in the left upper jaw are very loose, and embedded in a large fungating mass involving the gum on both sides of the alveolus and the adjacent part of the roof of the mouth. This mass is soft and ulcerated in two places, and bleeds readily. The gums of the right upper and of both lower jaws are red and spongy. The glands of the neck are enlarged on both sides, and more particularly on the left side beneath the sterno-mastoid and the angle of the jaw. These glands are not tender and in some places are quite separate, but in others appear to run together. Similar glands can be felt in the supra-sternal and both supra-clavicular fossæ, also in both axillæ, and in both groins. Both tonsils are enlarged, especially the left, which reaches the middle line. Patient shows general wasting, and there is a general well-marked pallor. On the front of the trunk and on all four extremities there

are irregularly distributed petechiæ, some darker in colour than others, varying from red to brown. The spots occur as high as the neck, and the back, especially in the upper part, is covered with them. The pulse is rapid, 128 to the minute, regular in force and rhythm, and the tension is somewhat increased. Respiration 28 to the minute. There is nothing abnormal to be seen in either fundus oculi. The knee-jerks are present, and there is no œdema of the legs. The temperature is 101·5°.

Circulatory system.—Nothing abnormal beyond the presence of two soft but distinct systolic murmurs heard, one at the apex and the other at the pulmonary cartilage.

Respiratory system.—No definite physical signs, but the upper limit of the liver dulness is raised in front. There is dulness to percussion, and the breath-sounds are weak at the base of the right axilla. An occasional rhonchus is heard in both lungs.

Abdominal system.—The abdomen is somewhat distended. There is no pain or tenderness. Percussion note is everywhere resonant. The liver and spleen and kidneys are not to be felt.

Urinary system.—No symptoms; urine normal in colour, sp. gr. 1025, deposits urates, and there is a trace of albumen.

February 24th.—Three loose stools were passed during the night, each of which contained blood-stained fæces; no clots.

26th.—Temperature rose to 102·6° last night. Diarrhœa is present, with blood in the stools, but less severe to-day. The abdomen is distended and tympanitic. A gland in the right groin is tender, but there are no signs of inflammation in its neighbourhood. During the night the patient noticed a painful spot on the right buttock; near its position the skin is reddened over an area about half an inch in diameter, and near the centre it is raised and darker than elsewhere. Nothing could be made out *per rectum* to account for the hæmorrhage from the bowel. The examination of the blood shows an increase in the

white corpuscles. There are no hæmorrhages into the retinæ.

28th.—Temperature reached 103·8° to-day. The blood was examined to-day and estimations of the red corpuscles made; one showed 2,225,000 per cubic millimetre, the other 2,500,000. One estimation of hæmoglobin showed 40 per cent., the second 30 per cent.; the proportion of red to white was as 35 to 1. There has been no more blood in the motions. The abdomen is distended, and the purpuric area on the right buttock has increased in size, and the skin over it is broken. The spots on the back are beginning to fade.

March 2nd.—The face is still swollen and the left eyelid puffy, and the sloughy condition of the mucous membrane covering the left upper jaw has increased. On the face two or three areas of ill-defined purpura have developed, somewhat slightly raised above the surrounding surface, something like the patch above noticed on the right buttock.

3rd.—The blood was stained to-day with eosin and methylene blue. A large increase of white corpuscles is well shown; many are stained blue only, and are mononuclear and large. Others have very irregular nuclei, and resemble the ordinary polymorpho-nuclear cells of normal blood. There are numerous cells with well-marked eosinophilic granules. There are no nucleated red corpuscles. Comparing the estimate with that of February 28th there is a further increase in the number of white corpuscles present. There has been some nose-bleeding this morning, and the gums tend to bleed rather freely. There are some spots on the conjunctiva of the left eye resembling purpura. It is doubtful whether the pain on pressure on the long bones is greater than normal.

4th.—The examination of blood shows red corpuscles 2,000,000 per cubic millimetre; the proportion of white to red is 1 to 7.

5th.—Patient looks, if possible, paler to-day. The increase in the hæmorrhage from the gums was checked

by an application of perchloride of iron. Patient complained of pain over the lower part of the chest and over the upper part of the abdomen. The purpuric areas on the face have increased in size. Towards evening the patient suddenly became collapsed, and died at 9 p.m. The patient was febrile throughout his illness; highest temperature 103·8°. He was sick on two occasions, and his urine constantly contained albumen.

Post-mortem (seventeen hours after death).—*Head.*—There was no hæmorrhage into the meninges, but small hæmorrhages were seen in the brain substance on section, and also in the choroid plexuses.

Chest.—Thymus persistent, measured three inches in length. Petechiæ were present on the heart, especially near the apex, in front of the right ventricle, on the parietal pericardium, on the base of both lungs, and on the parietal pleura, also under the endocardium of the right auricle and left ventricle. The heart weighed 16 ounces. Its muscular substance was healthy-looking and not very soft. The left ventricle not dilated, aortic valves somewhat fibrosed, and two of them were fused together. The mitral valves showed some minute vegetations, especially on the auricular aspect, and the valves were somewhat thickened; the other valves were normal. There was slight atheroma at the commencement of the aorta. The lungs were crepitant throughout, and there was no hæmorrhage into them. A little rather recent lymph was present at the posterior border of the right lung, and at the bases of both lungs. At the bifurcation of the trachea there was a mass of large glands. On section of the glands the surface was seen to be mottled yellow and dark red, and there were some cretaceous masses also cut across. No free fluid in either side of the chest, no tubercle in the lungs.

Abdomen.—There was recent lymph in the peritoneal cavity, and also some yellowish fluid, especially in the pelvis. The lymph was most marked in the right flank.

Petechiæ were present all over the peritoneum, but more especially under the peritoneum covering the intestines.

The intestines were distended, and hæmorrhages were seen, both wide-spread and small, under the mucous membrane. In the middle of the small intestine the mucous membrane was raised into numerous elevations of the size of large peas, the summit of each being completely covered with mucous membrane, and when incised seemed to be composed of soft tissue darkly blood-stained. Throughout the intestinal tract, and especially in the stomach, there were numerous small whitish nodules shining through the mucous membrane. In many places the wall of the gut was much pigmented, and this was especially the case in the Peyer's patches.

The mesenteric and other lymphatic glands of the abdomen and pelvis were greatly enlarged, and were dark in colour. On section the cut surface was mottled dark red and yellow. The substance of the glands was very soft and pulpy. The spleen was enlarged, weighing 20 ounces. It did not reach below the costal margin. It was reddish in colour and a little tougher than natural. There were traces of small whitish deposits in it.

The liver weighed 4 lbs. On section the cut surface was light red in colour, and the organ was infiltrated with an immense number of minute whitish deposits about the size of a pin's head.

Both kidneys were enlarged; the capsule stripped off easily. The cortex was pale, and the right kidney weighed 8 ounces. On the left side there was an extensive hæmorrhage under the epithelium of the right renal pelvis. The bladder contained several ounces of urine, free from blood but containing albumen; there were some petechiæ on its inner surface. Parts of both femora were removed; the marrow in each looked red, and in places resembled red-currant jelly. The sternum and ribs on section showed the marrow rather paler than normal. There was an extravasation of blood into the right rectus abdominis, where it lay over the right lower

ribs, and a patch of recent blood extravasation was seen under the skin of the left thigh. The glands of the groin and axilla were dissected, and were found to be free from hæmorrhage, and contrasted with the mesenteric glands. The cervical glands were also free from hæmorrhage.

Case 4.—Albert M—, aged 7 years. Admitted March 15th, 1897; died March 23rd, 1897. Patient was admitted with following symptoms:

(1) Swelling of the face (nose and lip) and neck.

(2) Loss of appetite and exhaustion.

(3) Pain in the right side.

March 15th, 1897.—Previous to the beginning of February, 1897, patient was quite well; he then complained of pain in the right side, and felt very hot and feverish. The doctor called in said that the patient had "inflammation of the lungs." Patient was kept in bed for three weeks, and got a little better and was allowed to get up, but he was then found to be very weak, and coughed a good deal; cough was dry and hacking in character, and patient is said by his mother to have coughed up small lumps of material like "pale blood." His appetite was noticed to be poor.

At the end of February patient was brought to this hospital. The pain in the side was much better, but the cough was still present, and the weakness had increased. At this time there was no very marked swelling in the neck and face, but some glandular enlargement was noticed on both sides of the neck. The mother was given some ointment to rub into the neck and some medicine to be given internally.

On March 4th the patient was again brought to the hospital, *i. e.* about a week since last visit. The enlargement of the glands in the neck was less, the cough was better, nor was there any pain in the side; but the weakness had greatly increased, so marked was it that patient could not walk from his home to the hospital.

11th.—Mother again brought the child to the hospital, as he had become much worse—losing flesh and perspiring very freely at night while asleep. His breath, which had become offensive lately, was now much more so.

On March 14th, the child's face was first noticed to be swollen, especially the lips and nose. The child was admitted into the hospital on the 15th March, 1897.

Ever since the beginning of February patient has been getting thinner and paler. Previous to this he was a rosy-cheeked well-nourished child. He has never been sick; his bowels have been rather constipated, more at times than others.

Past illnesses.—Measles in 1895, whooping-cough in 1896. No scarlet fever or other illness beyond bad colds.

Family history.—Mother, aged 41, alive and fairly well. She has had eight miscarriages—eight full-time children, and only four of latter are alive: it is doubtful whether the other four died of consumption. Father, aged 38, alive, not strong. His mother died of consumption. Patient is the youngest child but one alive; the other three are weakly.

General history.—House clean and dry. The children, however, have ailed since they went to live at Pentonville.

Present state.—Patient is an ill-nourished spare child of 7 years. He is very pale, and the sclerotics look very blue. There are purpuric spots on the body, more especially at the back and upper part of the chest, and in front on the lower part of the neck, and slightly on the right side of the neck, also on the front of the legs, more especially on the left thigh, and on both aspects of the arms, especially the left. Patient sweats rather freely, and the skin of the body is smooth and moist; the veins of the hands show through the skin; there is no œdema anywhere, and no pain on percussion of the bones; knee-jerks present. Two slight abrasions of the skin are present on the right side of the face near the eye (see photo-

graph, Pl. XI), with a certain amount of pigmentation as if due to blood extravasated beneath.

Mouth.—There is a sanious discharge from the nostrils, and swelling and redness around the left nostril. The upper lip is swollen and lifted off the upper jaw. The mucous membrane over the swollen part is ulcerated for about half a square inch. The mucous membranes generally are very pale. The incisor teeth of the *lower* jaw are rather loose. There is a good deal of swelling of the mucous membrane covering the right upper jaw, involving also the hard palate; there is some hæmorrhage from the right upper gum, slight ulceration being present. The gum of the right lower jaw is also swollen, and bleeds a little. The breath is very offensive.

There is a definite glandular enlargement in the neck, none in the axillæ or groins; the largest gland in the latter position is not larger than a haricot bean.

In the neck the glands are enlarged in both posterior triangles, near the angles of the jaw, below the lobules of the ears, along the anterior border of the sterno-mastoids, and beneath the body of the lower jaw. The greatest glandular enlargement is on the right side of the neck, and the largest gland is almost as big as a pigeon's egg, and is just below the right lower jaw. The glands are moveable, separate from one another, and on left side rather tender.

The appetite is fairly good, but it is painful to patient to take his food. Bowels regular. No purpura under conjunctivæ. Radial pulse is fairly compressible—160 to the minute, regular in force and rhythm. Respiration 24, temperature 102·8°. Pupils are widely dilated, equal, and react to light and accommodation. Movements of eyeballs normal.

Circulatory system.—The vessels of the neck pulsate markedly from clavicles to lobules of ears. External jugular veins are not distended. The cardiac impulse is somewhat diffuse in the third, fourth, and fifth spaces to the left side of sternum, internal to the nipple line. There

is no marked enlargement of heart; an apical systolic murmur and a systolic murmur at the pulmonary cartilage, where the second sound is accentuated, are heard.

Respiratory system.—Patient has a slight cough. There are no signs except numerous râles and rhonchi on both sides of the chest, and these are especially marked at the bases.

Abdominal system.—No symptoms. Abdomen is slightly distended, but moves well on respiration; no mass to be felt, but there is some resistance below the right costal margin down to the level of the umbilicus. Edge of liver not definable. The spleen can be felt a finger's breadth below left costal margin. Dulness to percussion is noticeable below right costal margin to within a finger's breadth of umbilicus. There is some pain on deep palpation of the right iliac region.

Urinary system.—No albumen, no blood.

March 15th.—Blood examination: hæmoglobin, 36 per cent.; red corpuscles, 1,480,000 per c.mm.; white to red, 1 in 43. By staining there was found a great increase in the number of large mononuclear cells.

17th.—Upper lip was swollen; motion to-day quite free from blood, but very offensive.

18th.—There was a good deal of fever; patient's upper lip has become much more enlarged, and the surface of the mucous membrane is very excoriated. Gums as before. Tonsils are pale and not enlarged. The glands in the neck are more tender than on admission. No hæmorrhages were seen in retinæ. A dark and deeply seated purpuric spot has developed over right buttock. Other purpuric spots are unaltered. Pulse getting more frequent. Blood examination: hæmoglobin, not examined; red corpuscles, 45 per cent.; white to red, 1 in 33.

19th.—Two sore places have been noticed on the back of the head to-day near occiput. There is tenderness over them, and they are raised above the skin. It is very difficult to feed the patient, as he complains so much during the feeding, not at other times.

21st.—Sore places on back of head are more tender and more extensive. The two patches noticed on right side of face are more pronounced. Over the right wrist a papule, first noticed on March 15th, has now become almost as big as a pea. The upper lip is still swollen, and its surface covered with a brownish-black scab. There is a purulent discharge from the nostrils. Deep-seated purpuric patches have developed on the legs. The patient complains of pain in the abdomen. The spleen is not so much enlarged as it was. The pain in the abdomen cannot be localised, nor is it increased by pressure. A motion passed this morning looked tar-like in colour and consistency. Patient is difficult to feed, and he is very fretful; much œdema about right eye.

22nd.—Blood examination: hæmoglobin, 26 per cent.; red corpuscles, 30 per cent.; 1 white to 25 red.

23rd.—The two patches to the right of the right eye are much larger to-day, and show more red colour; they are scaly on the surface. A cultivation was attempted from the blood to-day (no growth was obtained by Dr. Curtis). Breath is still very offensive. Right upper gum is less swollen than it was, and paler. Patient's skin looks very waxy, and the veins show through very distinctly as pink lines. Raised area over right wrist is more extensive. Bowels confined. Pulse and respiration are 154 and 48 to the minute. Patient became gradually weaker during his stay in hospital, and rapidly sank and died to-day. Temperature on March 17th and 18th reached 105·4°; at death it was 100°. A trace of albumen appeared in the urine towards the last.

Autopsy (March 24th, seventeen hours after death.)—Rigor mortis present in slight amount.

Head.—Brain very pale; no hæmorrhages into it or into the meninges; 2 or 3 drachms of clear fluid in cranium after removal of brain. A portion of the gum of the right upper jaw was removed and placed in alcohol. It was not ulcerated, nor did the bone seem necrosed. One of the enlarged glands on the right side of the neck

was removed, and on section was pale, with some reddish coloration. No tubercle present, and centre not softened.

Chest.—Thymus present, not particularly enlarged. It was very pale, and was separated with difficulty from surrounding tissues. Pericardium contained a couple of drachms of straw-coloured fluid. Petechiæ present on right auricle and right ventricle. All the valves were normal except the aortic, which was a little thickened; the right lung was adherent at the apex. Both lungs showed emphysema, collapse, and broncho-pneumonia. There was purulent (?) secretion in many bronchioles. Glands in the posterior mediastinum only slightly enlarged, but redder than normal.

Abdomen.—Liver weighed 1 lb. 12 oz.; it was fatty and free from adenoid growth.

Spleen weighed 4½ ounces. On section the surface was somewhat mottled, reddish and purple. Spleen rather soft, and on surface at one spot there was a yellowish deposit. On cutting through this the outline was irregularly conical, and the deposit was sharply marked off from the spleen substance.

Kidneys.—Each kidney weighed 4½ ounces. They were pale, and scattered through the cortex were definite deposits, and in one of these deposits there was some hæmorrhage.

There were a few petechiæ in the omentum and peritoneum.

The glands of the mesentery were not enlarged, but some of them were redder than normal.

Intestines.—There was a small hæmorrhage in one part of the small intestines. In the duodenum there were four places where the mucous membrane had been raised by gas (probably due to decomposition). There was a similar appearance of emphysema in one of the mesenteric glands.

The lower part of the large intestine was dotted over with rather pale elevations with little black centres, as if due to old hæmorrhages into them.

Marrow.—In the femur the marrow was of the colour of fuller's-earth ; in no place was there an appearance of red-currant jelly. The marrow of the sternum was pale brown, as was also the case in the ribs.

An occasional small hæmorrhage was found in the muscles of the chest wall.

Nothing was found to account for the tarry motions. Towards the lower end of the ileum, near the ileo-cæcal valve, there seemed to be some slight increase in the lymphoid tissue of the solitary follicles, but there was no definite heaping up. Almost throughout the small intestines the Peyer's patches were darker than normal, but not at all prominent.

Case 5.—W. G—, aged 17, schoolboy, was seen by one of us (J. R. B.) on December 16th, 1897, in consultation with Dr. Bontor of Berkhamsted.

Patient, although always delicate, has had no previous serious illness, and has been quite well until about five weeks previously.

The only point of interest in his past history was that he disliked most fresh vegetables, and had got into the habit of rarely if ever eating any. Five weeks before seeing him patient had been taken ill with vague symptoms of general malaise and weakness, but he recovered sufficiently to come home from school in about a fortnight from the onset. At this time he was sufficiently well to be up and about, but was noticed to be very weak and extraordinarily pale. He improved somewhat under treatment, and was able to go out, but very soon the weakness and pallor returned in an aggravated form, and patient was confined to his bed. About a week before he was seen by one of us the gums began to swell. He had no nose-bleeding, nor hæmorrhage from any mucous surface. When seen the patient was extraordinarily pale ; the mouth was half open, the gums were swollen to such an extent that the teeth were lying in a furrow. The breath was very offensive, and the gums in places were

sloughing. There was considerable enlargement of the cervical glands, and the glands in the left groin were also slightly enlarged, but were not very tender; the bones, on the other hand, were exceedingly tender. The abdomen was distended. The tip of the spleen could just be felt below the costal margin; the liver was not felt. There was very great dyspnœa, and the pulse was rapid and exceedingly weak. Further examination of the blood showed that there was great excess of white corpuscles, but a differential count could not be made, as no hæmocytometer was available. The films were, however, stained, and the results are given below. The patient died the same night, and a post-mortem examination was not obtained.

We shall use the following nomenclature in describing the variety of white cells present in the blood in these cases:

(1) Lymphocyte—large or small. The small lymphocytes stain deeply, and have a round nucleus concentrically situated in the cell. These small lymphocytes are from 5 to 6 μ in diameter.

(2) The large lymphocytes. These stain faintly; the nucleus is of variable shape, generally central in position; the protoplasm is more abundant than in the small variety. The size of the cell is variable, but we have found some reaching from 16 to 18 μ.

(3) Polymorpho-nuclear cells. This is the most convenient term by which to describe the ordinary and most abundant white corpuscle of normal blood. The nucleus is partite, irregularly stained, and the cells contain oxyphile granules, always small.

(4) Coarse oxyphile cells of varying size, the nucleus single or partite. These cells are readily recognised, as they invariably contain very coarse oxyphile granules.

(5) Myelocyte. The nucleus stains faintly with methylene blue, and it may be round, oval, or lobed, and is situated at one pole of the cell, and the contour of the nucleus

is in close contact with the cell wall over a portion of its extent. The granules are usually oxyphile and small. The size of the cell is variable, but they are met with up to 20 μ in diameter.

Description of the blood.[1]

Case 3.—George D—. Proportion of white to red varied between 1 to 7 and 1 to 35. No nucleated red corpuscles were found. The highest number of red corpuscles observed was 2,500,000, the lowest number observed 2,000,000; white corpuscles 74,000 to 280,000. Percentage of different kinds of corpuscles: small lymphocyte, 6·9 per cent.; large lymphocyte, 90·4 per cent.; polymorpho-nuclear, ·5 per cent.; coarse oxyphile, 1·6 per cent.; myelocyte, ·6 per cent.

Total number of white corpuscles counted, 4000. (Plate X, fig. 1.)

Case 4.—Albert M—. Proportion of white to red varied from 1 to 25 to 1 to 43. No nucleated red corpuscles were seen. Highest number of red corpuscles 2,500,000, lowest 1,500,000. Number of white corpuscles varied from 34,500 to 68,000 per c.mm.; small lymphocytes, 12·2 per cent. and 13.4 per cent.; large lymphocytes, 61·8 per cent. and 64·3 per cent.; polymorpho-nuclear and coarse oxyphile, 26 per cent. and 22·3 per cent.; myelocyte 0 per cent.

Note.—The coarse oxyphile cells were very scarce, but were present. No myelocytes were seen, with one doubtful exception. Total number of white corpuscles counted, 1402. (Plate X, fig. 2.)

Case 5.—W. G—. Great excess of white corpuscles present, but no count made, as no hæmocytometer was available. Small lymphocytes, ·88 per cent.; large lymphocytes, 98·49 per cent.; polymorpho-nuclear, none found; coarse oxyphile, ·23 per cent.; myelocytes, ·4 per cent. (Plate X, fig. 3.)

[1] It will be remembered that in Cases 1 and 2 stained films were not made.

Films from the marrow in the shaft of the femur were made in Cases 3 and 4; the differential counts yielded the following results:

Case 3.—Small lymphocytes, 3·3 per cent.; large lymphocytes, 92·6 per cent.; polymorpho-nuclear, none found; coarse oxyphile, none found; myelocytes, 4·1 per cent.

Total number of corpuscles counted, 832.

Case 4.—Small lymphocytes, 16·8 per cent.; large lymphocytes, 82·2 per cent.; polymorpho-nuclear, 0·2 per cent.; coarse oxyphile, 0·6 per cent.; myelocytes, 0·2 per cent.

The blood examination in all five cases shows that they were all undoubtedly cases of leukæmia. It is unfortunate that in the first two cases stained blood films were not made, so that we are unable to say whether the leukæmia in these cases was dependent upon an excess of lymphocytes, large or small, or whether the leukæmia was a mixed one. The fact, however, that in case No. 1 the number of white cells reached the proportion of one white to less than four red, and in case No. 2 one white to ten red, shows that these were undoubted cases of leukæmia, and not cases of some secondary form of leucocytosis.

All the cases came under observation for anæmia or for gangrenous stomatitis, but in all the five cases there was distinct evidence that the stomatitis was not an initial symptom. In case No. 2 the state of the patient precluded a satisfactory history, but it is clear that weakness preceded the stomatitis. In case No. 1 the gums are merely noted as "spongy" when the patient was first seen, and there was then no sloughing of the gum; the patient, however, was extremely weak and intensely pallid. In case No. 3 one of us (J. R. B.) saw the patient in the Out-patient Department of University College Hospital some four weeks before he was admitted, and examined the mouth specially in order to determine,

if possible, the cause of the enlargement of the glands of the left side of the neck, but nothing abnormal in the mouth was detected at this period. This patient came to the Out-patient Department complaining of weakness and of the enlargement of the cervical glands, and he was even then very pale.

In case No. 4 the history is definite that the child was ill previously to the onset of the stomatitis, and in the fifth case Dr. Bontor examined the mouth at the commencement of the illness, and found nothing abnormal until the last week of the patient's life. It is therefore evident that although finally the stomatitis was the most prominent clinical feature apart from the intense anæmia, yet this stomatitis was not the initial lesion, although without a blood examination it would have been easy to mistake these cases clinically for cases of stomatitis. The degree of anæmia was very remarkable, and, in fact, it was so intense and peculiar that the nature of the cases could be recognised almost by this sign alone. The illness in all five cases was accompanied by fever, and in No. 4 this was considerable, reaching 105·4°: in all the other cases the temperature rarely exceeded or reached 102°. In No. 3 the teeth were found at the post-mortem to be loose; the cause of this was not satisfactorily determined.

The degree of leukæmia varied in the four cases where the amount could be determined, the extremes being 1 to less than 4 red in case No. 1, and 1 to 43 red in case No. 4. In No. 5 the excess was very great, but no hæmocytometer was available. To the eye it appeared so great that the number of white corpuscles seemed almost to equal that of the red. The nature of the leukæmia in all the cases where the blood was stained showed that the excess of white cells was almost entirely dependent on the presence of the large variety of lymphocytes. In none of the cases where stained films were made was there any notable increase in the ordinary polymorpho-nuclear leucocyte, such as occurs in any secondary leucocytosis; and in

two out of the three cases examined (Nos. 3 and 5) these cells were extremely scanty. In the fourth case they only amounted to 26 per cent. In the third and fifth cases, in addition to a great excess of large lymphocytes, there were a few myelocytes, but nothing comparable to the increase seen in ordinary spleno-myelogenous leukæmia. In all cases there was not only a great diminution in the number of red corpuscles, but there was also a great diminution in the amount of blood, as it was often difficult to obtain blood freely on puncturing the finger. On post-mortem examination, although the bulky clots described by some authors in ordinary chronic leukæmia were not obvious, yet the "café au lait" colour of the blood was very striking. The stomatitis was extreme in amount, and the sloughing and gangrene of the gums, palate, and sometimes of the cheek and lips caused excessive fœtor of the breath. In one case (No. 5) the swelling of the gums was so extreme as to cause the teeth to lie in a furrow; in others the swelling and gangrene were localised, and more especially affected the parietal mucous membrane of the inside of the cheek or lips, leading in two cases (Nos. 1 and 3) to so much swelling of the cheek that a growth of the superior maxilla was at one time suggested as a possible diagnosis before the blood examination revealed the nature of the cases.

In all the cases examined post mortem it was seen that, however extensive the swelling and gangrene of the soft parts of the gums, lips, and cheeks had been, there was no obvious disease of the periosteum or of the bones.

Stomatitis is also occasionally seen in the other and more common chronic form of leukæmia, and depends probably upon the leukæmic infiltration of the gums, &c., with subsequent hæmorrhage into the morbid tissue, and in this way the sloughs and gangrene are produced. The lesions in the gums are very similar in their minute anatomy to the lesions found in one of the cases (No. 3) in the intestines and in the brain. In all the cases there was some enlargement of the superficial lymphatic glands,

and in all cases examined post mortem the abdominal glands, mesenteric and retro-peritoneal, were enlarged except in case No. 4. In three cases (Nos. 3, 4, and 5) the enlargement of the superficial glands was obvious, but in only one (No. 3) was it very marked. In this case undoubtedly the enlargement of the lymphatic glands and of the lymphoid tissue of the intestine was the most prominent feature of the morbid anatomy. In two cases (Nos. 1 and 3) the enlarged abdominal lymphatic glands were soft, and in places almost diffluent. The other glands in these two cases and all the glands in the other two cases examined post mortem were firm on section. In the only case (No. 5) not examined post mortem the accessible glands felt firm, and were but slightly enlarged, except the cervical glands, which were considerably enlarged. In two cases only (Nos. 3 and 5) could the spleen be felt during life, and then only to the extent of a couple of fingers below the costal margin. In two cases no enlargement was found after death. In the other two there was some enlargement; but even in No. 3, where the maximum enlargement occurred, the organ weighed but 20 ounces. In all the cases examined post mortem the thymus was found present or enlarged. The marrow of the long bones was in all the cases diseased; in three (Nos. 1, 2, and 3) it was red and jelly-like in consistence, and in No. 4 it had a puriform aspect, and in no case was the normal fatty marrow present in the shafts of the long bones. Clinically some of the cases presented tenderness of the bones, and in one case (No. 5) this was a very marked feature. The purpuric hæmorrhages in the skin and in the serous membranes to a slighter extent were present in four out of five of the cases, and melæna was present in at least two cases (Nos. 3 and 4). In No. 3 it was occasionally marked, and in this case it may have arisen from the hæmorrhages into the hypertrophied lymphoid tissue of the intestine, leading to the formation of small hæmorrhagic ulcers, although no such ulcer was found post mortem. In all cases the illness was very

acute, and the duration did not exceed eight weeks in any case. Death resulted from asthenia from the intense anæmia, and was not caused by inflammation of the serous membranes or viscera. In the only case (No. 3) where there were signs of serous inflammation in the pleura and peritoneum this was very slight in amount, and in No. 4 there was some broncho-pneumonia.

These cases resemble those described in 1895 by Fraenkel,[1] although in many of his cases described under the term "acute" the duration was longer than six weeks. It is perhaps doubtful whether these cases should be described as cases of acute lymphatic leukæmia, since in some of them this nomenclature is liable to cause confusion.

Lymphatic leukæmia may mean one of two things: (1) a variety of leukæmia where the main post-mortem lesion is enlargement of the lymphatic glands or other lymphatic tissue; (2) a variety of leukæmia in which the excess of white cells in the blood consists largely of lymphocytes, large or small. It is very probable, but not absolutely certain, that these two conditions are really one and the same; but certainly some cases of leukæmia not reported in this series, and characterised clinically by great splenic enlargement, show that the leukæmic condition of the blood is dependent mainly upon the presence of lymphocytes. Further, in Cases 3 and 4, where there was most lymphatic enlargement, the blood condition was not one showing a simple increase of lymphocytes, although these formed the bulk of the white cells present; there were in addition a few myelocytes, doubtless associated with the disease of the bone marrow. It is only right to say that in cases described as "acute lymphatic leukæmia" by other authors, myelocytes were present to a small extent in the blood, as in our cases. Hence we think it better to describe these cases simply as cases of acute leukæmia, although in many respects, and especially in the great

[1] Fraenkel, 'Deutsche medicinische Wochenschrift,' 1895, pp. 639, 663, 699, 712. Other references to the subject will be found in this paper.

abundance of the large lymphocytes in the blood, they resemble and are probably identical with the cases described by other authors as "acute lymphatic leukæmia." However, the first case, at any rate, might, from the post-mortem lesions, be fairly described as a case of pure myelogenous leukæmia, since the spleen was normal in size; and although the lymphatic glands all over the body were enlarged and soft, yet the biggest was but the size of the thumb-nail. On the other hand, the medulla of all the long bones examined was diseased, and there was a very great increase in the white cells of the blood in this case; but unfortunately no stained films were made, so there is no evidence to say what variety of cell predominated, whether lymphocyte or myelocyte. It is remarkable that in Case 4, where the lymphatic glands were not excessively enlarged, except in the neck, where they were moderately enlarged, and the spleen was but slightly enlarged, the excess of white cells in the blood should have consisted almost entirely of lymphocytes. The marrow in this case was excessively diseased, and of the type that has been described by some authors as puriform, and this marrow contained very large numbers of lymphocytes.

Clinically these cases presented a superficial resemblance to certain other diseases, and more especially to purpura and to scurvy. They resembled these maladies in the presence of purpuric hæmorrhages, of sponginess, necrosis, and ulceration of the gums; and in one case (No. 5) there was a history of the patient having avoided vegetables. They were, however, very sharply marked off from these two maladies by the blood examination, as both the number and the character of the leucocytes were quite incompatible with any secondary blood change dependent on anæmia. The blood examination also separated the cases at once from any septic infection arising from a primary stomatitis, since such a leucocytosis would be dependent upon the presence of polymorpho-nuclear cells. These, however, as mentioned above, were always

rare and sometimes absent, the leukæmia being dependent upon the presence of lymphocytes. Further, as mentioned in the clinical record, the stomatitis was a terminal and not an initial symptom. The clinical resemblance to one another of all the cases described by us was so great that we think there can be no doubt that they form a definite and separate group.

(For report of the discussion on this paper, see 'Proceedings of the Royal Medical and Chirurgical Society,' Third Series, vol. x, p. 147.)

TABLE OF CASES.

Case.	Age.	Sex.	Duration of illness.	Purpura.	Melæna.	Tenderness of bones.	Condition of thymus.	Condition of gums and mouth.	Condition of marrow.	Condition of spleen.
No. 1	30	M.	6–8 weeks	Yes	Not observed	Not observed	$3\frac{1}{2} \times 1\frac{1}{2}$ inches	Stomatitis present, coming on *2 weeks* after beginning of illness	Hæmorrhagic and red and gelatinous	Could not be felt during life; not enlarged P.M.
No. 2	58	M.	5–6 weeks	Yes	Not observed	Not observed	Present	Stomatitis present, coming on *3 weeks* after beginning of illness	Red and gelatinous	Could not be felt during life; slightly increased P.M.
No. 3	19	M.	$5\frac{1}{2}$ week	Yes	Yes	No	3 inches long	Stomatitis found, coming on *2 weeks* after beginning of illness	Red and gelatinous; microscopically many large lymphocytes and some myelocytes	Could not be felt during life; weighed 20 oz. at autopsy
No. 4	7	M.	7 weeks	Yes	Yes	No	Present, not enlarged	Stomatitis present, coming on *5–6 weeks* after beginning of illness	Puriform, not red anywhere; microscopically large lymphocytes increased, but only few myelocytes	Could be just felt during life; weighed $4\frac{1}{2}$ oz.
No. 5	17	M.	5 weeks	None observed	No	Yes	—	Stomatitis present, coming on *4 weeks* after beginning of illness	—	Could just be felt during life

Condition of glands.	Blood.								Nucleated red corpuscles.	Albumen in urine.	Maximum temperature.
	No. of red per c.mm.	Hb.	No. of white to red.	Small lymphocytes.	Large lymphocytes.	Myelocytes.	Coarse oxyphile.	Polymorphonuclear.			
Universally enlarged, but especially in neck	(1) 2,050,000	40%	1 : 3·70	Not observed					—	Trace	102·2°
	(2) 2,390,000		1 : 10								
	(3) 1,050,000		1 : 5								
Universally slightly enlarged	—	—	1 : 10	Not observed					—	Nil	100·2°
Superficial glands enlarged, specially in neck; also deep, as in abdomen and thorax. Note deposits in intestines and brain	(1) 2,000,000	30% to 40%	(1) 1 : 35	Reduced	Greatly multiplied	Present	Present	Greatly reduced	None found	Trace	103·8°
	(2) 2,500,000		(2) 1 : 7								
Only the cervical group of superficial glands enlarged; deep scarcely at all	(1) 1,500,000	36%	1 : 43	Normal or reduced	Greatly multiplied	Absent	Present	Present, but reduced	None found	Trace	105·4°
	(2) 2,500,000	26%	1 : 35								
			1 : 25								
Cervical glands especially enlarged; also some in left groin	—	—	—	Reduced	Greatly multiplied	Present	Present	Absent	None found	—	—

DESCRIPTION OF PLATE X.

On Five Cases of Acute Leukæmia (Dr. J. Rose Bradford and Dr. H. Batty Shaw).

In all cases the blood was stained with eosin and methylene blue, $\frac{1}{12}$ oil immersion was used, and the corpuscles drawn to scale.

In each of the figures—

A = Lymphocyte, large variety.
B = Myelocyte.
C = Lymphocyte, small variety.
D = Coarsely granular oxyphile cell.
E = Polymorpho-nuclear cell.
H = Red corpuscle.
J = Lymphocyte, intermediate in size between A and C.

Fig. 1—Blood film from Case 3.
Fig. 2—Blood film from Case 4.
Fig. 3—Blood film from Case 5.

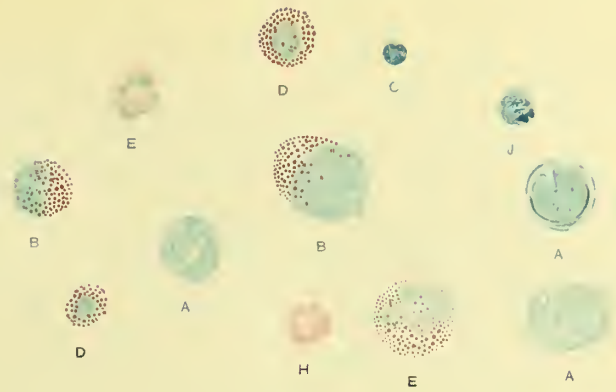

Fig. 1.

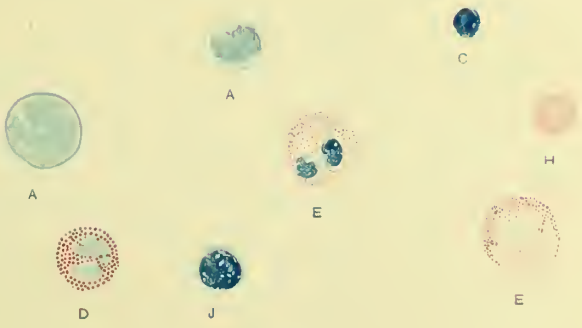

Fig. 2.

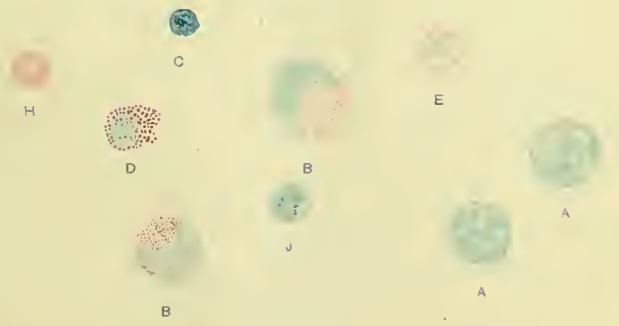

Fig. 3.

30μ

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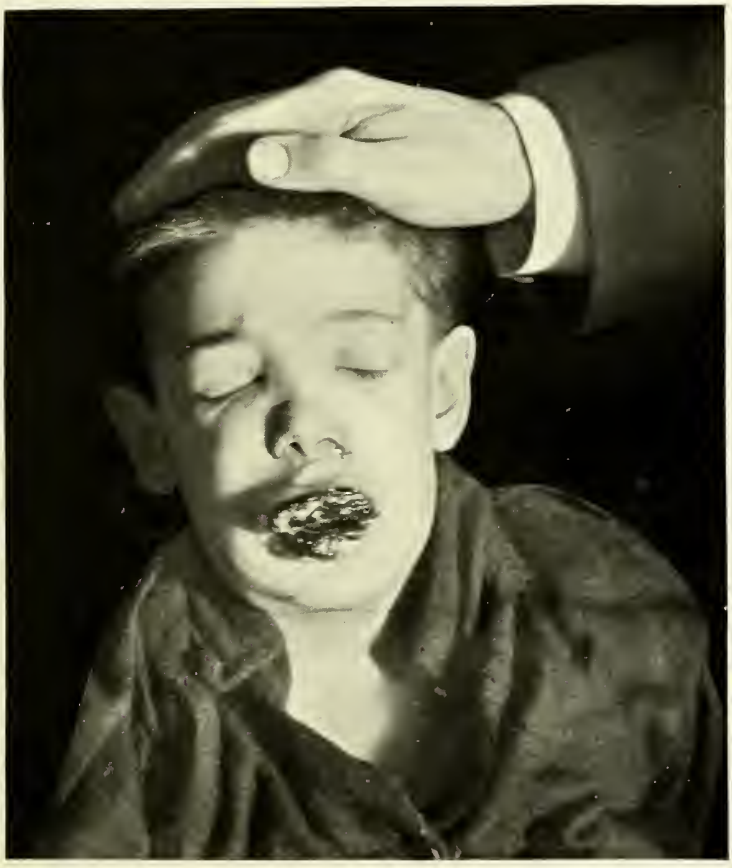
DESCRIPTION OF PLATE XI.

On Five Cases of Acute Leukæmia (Dr. J. Rose Bradford and Dr. H. Batty Shaw).

Photograph of Case 4, showing the swelling and ulceration of the lips.



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